NASA Activities

National
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Space
Administration

25
25th Anniversary
1958-1983

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About the Cover

The X-15, the rocket plane that advanced the knowledge of how man and machine function in the realm of hypersonic flight, is shown attached under the wing of its carrier aircraft, an Air Force B-52. The X-15 was launched from beneath the wing of the B-52 (bottom frame) once that aircraft had reached an altitude of 13,716 m (45,000 ft) and a speed greater than 805 km/hour (500 mph). Freed from the B-52s wing, the X-15 engine fired, rocketing the plane downrange at hypersonic speed (five times the speed of sound). Its flight completed, the craft glided to a 322 km/hr (200 mph) landing on a dry lake bed at Edwards, Calif., using a conventional nose-wheel landing gear and ski-like skids at the rear.

Because the X-15 flew in a low space environment (flight above most of the Earth's atmosphere), it was able to provide data on a wide range of questions that would contribute significantly to the advancement of the nation's space program: the capabilities and limitations of a human pilot in an aerospace vehicle; the effects of weightlessness; high heat rates; steep reentry angles; and the difficulty of attitude control in space.

March 25 marks the 23d anniversary of the first flight of the X-15; this rocket plane concept went on the complete 199 flights in a joint NASA-Air Force-Navy research program before ending with its last flight on Oct. 24, 1968. During the 8½ years of the program, the X-15 set altitude and space records for winged aircraft that remained unchallenged until the first flight of the nation's first true aerospace vehicle, the Space Shuttle, on April 12, 1981. An X-15 achieved an altitude of 17,960 meters (354,200 ft., or more than 67 miles) and, on another flight, a modified X-15 reached a speed of 7,272 km/hour (4,520 mph)—6.7 times the speed of sound.

Twelve experienced military and civilian pilots flew the X-15, including Neil A. Armstrong, the first man to walk on the Moon; Joe H. Engle, the commander of the second Space Shuttle mission; and A. Scott Crossfield, the X-15's first pilot.

NASA's 25th Anniversary historical calendar of events for March (and more on the X-15) appears on page 8 of this issue.

Correction: In the December issue of NASA Activities, p. 23, the caption at top left read: ". . . The nearest star to Earth is 4 billion light years away . . ." This sentence should have read: "The nearest star to Earth, other than the Sun, is about 4 light years away."

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Administrator's Column

(In this column *NASA Activities* features an article by NASA Administrator James M. Beggs. These articles focus on subjects chosen by him that address topics of broad interest to the agency's employees. The column this month features testimony given by Administrator Beggs on Feb. 3 before the Committee on Science and Technology, House of Representatives, concerning NASA's Fiscal Year 1984 budget request.)

NASA's Budget Request For Fiscal Year 1984

It is a pleasure for me to appear before this distinguished Committee to present President Reagan's budget request for NASA for Fiscal Year 1984. The total request is $7.1 billion, of which $5.7 billion is for research and development, $150 million for construction of facilities, and $1.25 billion for research and program management.

I am particularly proud to be at NASA in 1983 to celebrate its 25th Anniversary. During the 25 years since the United States entered the Space Age, our space program has grown from the 14-kg Explorer, launched in January 1958, to a truly reusable Space Transportation System.

I would like to begin by discussing some of the achievements of the past year—achievements which have been very significant, indeed, and which would not have been possible without the strong and continued support of the Congress. In 1982, the Space Shuttle orbiter Columbia made three successful orbital flights and, during each flight, significant progress was made in understanding the operational features of the Shuttle system. This initial phase of the Space Transportation System flight program culminated with the first operational flight in November 1982, during which two commercial communications satellites were launched. There is no doubt in my mind that the investment this Nation has made in the Space Shuttle will pay off handsomely. We now know enough about the system that I can make this statement with great confidence.

A new Earth observation satellite, Landsat 4, was placed in Earth orbit in July 1982, and its operations have been spectacularly successful. The satellite's new thematic mapper has provided information of a quality exceeding the original specifications; it is providing valuable information for the geophysical sciences as well as excellent data for mapping and Earth resources assessment. Additionally, our Earth-orbiting scientific satellite and other spacecraft in the solar system have continued to operate and to return extremely valuable scientific information.

In aeronautics, the Department of Defense has recognized the importance of NASA's technical contributions by considering NASA's tilt-rotor aircraft concept as a prime contender for the new joint service JVX vertical take-off and landing aircraft program. The XV-15 experimental aircraft, jointly developed by the Army and NASA, served as the proof-of-concept vehicle which made this recognition possible. Two large new aeronautical facilities are nearing completion, the National Transonic Facility at Langley Research Center and the new 80 × 120 foot addition to the 40 × 80 foot Subsonic Wind Tunnel at Ames Research Center. The completion of operational test and checkout of the new 80 × 120 foot leg has recently suffered a set-back because of an accident during testing. The facility is expected to be operational in about two years. NASA hopes to repair the facility and return it to operation as soon as possible to minimize delays to a number of priority NASA, Department of Defense and industry testing programs.

I would now like to turn to another achievement, a renewed commitment to the American space program from the highest levels of this Administration. On July 4, 1982, President Reagan issued a policy statement which outlines basic U.S. goals for activities in space. These goals are:

- to strengthen the security of the United States;
- to maintain United States space leadership;
- to obtain economical and scientific benefits through the exploration of space;
- to expand United States private sector investment and involvement in civil and space related activities;
- to promote international cooperative activities in the national interest; and, finally,
- to cooperate with other nations in maintaining freedom of space for activities which enhance the security and welfare of mankind.

The NASA budget request for Fiscal Year 1984 is designed to achieve the objectives outlined in President Reagan's space policy—especially the maintenance of United States leadership in space. This is really the important word—leadership—and this Committee may rest assured that the Administration is strongly committed to what that word represents.

The key to leadership in space is to have efficient and effective ways of getting there. The President's space

policy strongly supports the Space Shuttle program, and calls the Shuttle "the primary space launch system for both United States national security and civil government missions."

NASA's proposed Fiscal Year 1984 budget fully supports a four-orbiter fleet, with enough structural and subsystem spares to make certain that the fleet is able to survive serious delays or accidents. Our proposal will also reduce the lead time for expansion or replacement of the four-orbiter fleet, if and when operational demands require. Our plans make it possible to meet the commitment to launch the payloads which we, and those depending upon us, have planned for at least the remainder of this decade. NASA's first priority remains: to make the Space Shuttle system fully operational as rapidly as possible. Additionally, we will continue to explore new ways of employing the full capability of the Shuttle. The proposed Fiscal Year 1984 request continues funding of activities leading to a Shuttle mission to recover and repair on orbit the partially defunct Solar Maximum Mission (SMM) spacecraft in 1984. This will provide more useful life for the important Solar Max objectives and demonstrate the Shuttle's ability to perform such operations. Later on this year, we are scheduled to fly the first Spacelab mission which is an important demonstration of the new capabilities represented by the Space Shuttle. Spacelab, developed and contributed by the European Space Agency, represents an important international activity consistent with the President's space policy. Another international contribution to the Space Shuttle program is the Remote Manipulator System which was provided by the government of Canada. The System successfully completed testing last year and in November was declared ready for operational use aboard future Shuttle flights.

NASA policy has recently been revised to expand opportunities for sponsors of Shuttle payloads to nominate payload specialists to fly with them. President Reagan invited a Brazilian payload specialist to fly aboard the Shuttle, and during his recent discussions with the Prime Minister of Japan, he extended a similar offer which was accepted. Australia and Canada have also accepted invitations for payload specialist nominations.

The second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE '82), held in Vienna last August, helped to promote greater international awareness of the practical benefits of the applications of space science and technology.

In my testimony before this Committee last year, I said that the Space Telescope will be the most important scientific instrument we have ever flown. I continue to believe this is true, and NASA's Fiscal Year 1984 budget request provides priority support to this very important development effort.

As might be expected in a program of this complexity, we are continuing to experience technical problems, particularly in the Optical Telescope Assembly development activities, which will most likely impact the scheduled launch and runout cost of the

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

BUDGET SUMMARY

BUDGET PLAN
(Thousands of Dollars)

BUDGET PLAN	FY 1982	FY 1983	FY 1984
Research and development	4,771,950	5,542,800	5,708,500
Construction of facilities	113,700	97,500	150,500
Research and program management	1,134,134	1,199,050	1,247,500
TOTAL BUDGET PLAN	6,019,784	6,839,350	7,106,500
OUTLAYS	6,035,401	6,721,500	6,981,100

Space Telescope. We are currently reviewing a range of alternatives for rephasing the work to minimize the cost and schedule impact. As soon as our evaluation is complete, we will inform the Committee of our proposed actions.

Excellent progress is being made in other areas related to the Space Telescope. In a few months, we will open the doors of the new Space Telescope Science Institute which has been established at the Johns Hopkins University. Software and procedures for carrying out scientific investigations with this very complex space observatory are on schedule. The Space Telescope will open a new era of scientific opportunity and permit the United States to retain world leadership in astronomy.

Another measure of leadership in space is the continuing enterprise of planetary exploration. We have included in the proposed Fiscal Year 1984 budget the initiation of a new program to map the surface of the planet Venus using radar imaging techniques. Within our overall strategy for planetary exploration, this initiative, the Venus Radar Mapper, estimated to cost in the $350 million range—replaces, at a much lower cost, the Venus Orbiting Imaging Radar mission authorized by the Congress to begin in Fiscal Year 1982. The Venus Radar Mapper Mission will help us understand why our sister planet, Venus, which is so much like the Earth in size and physical composition, yet so different in other respects, has followed such a different evolutionary history. We will search for detailed properties in common with the Earth, such as volcanic activity and continental drift. Aside from their intrinsic scientific value, observations provided by the Venus Radar Mapper will help us to understand more clearly the history, nature, and most importantly, the future of our own planet.

The Advanced Communications Technology Satellite (ACTS) project, another new initiative proposed in the FY 1984 budget, calls for development and flight testing of the high-risk technology needed to ensure continued United States preeminence in the field of satellite communications. The decision to propose the ACTS program is a result of extensive consultation with communication carriers, satellite system suppliers, and strong support from the Congress. The ACTS program will involve a novel procurement approach, including a cost/risk sharing arrangement with industry which will provide significant cost savings to the government.

Another goal of the President's space policy is to expand private sector investment and involvement in space activities. NASA has received proposals from the private sector to fund and/or operate launch vehicles. We are reviewing these proposals very carefully to determine costs and benefits, launch and tracking requirements, safety and security, as well as international considerations.

In addition to the President's space policy which I have already discussed, the Administration has developed a new policy statement governing the needs for and management of federally-funded research and development work in aeronautics. In November 1982, the President's Office of Science and Technology Policy released a document entitled,"Aeronautical Research and Technology Policy." The aeronautics program included in NASA's Fiscal Year 1984 budget request reflects many recommendations contained in this important policy statement. The most important facet of the Administration's new aeronautics policy is the recognition that a strong aeronautical industry is absolutely essential for both the National security and the health of our economy. Furthermore, this policy recognizes explicitly the important role the federal government, through NASA, plays in providing the basic technology which will assist the United States in maintaining and enhancing the leadership position in aviation which we now enjoy. In concert with this policy, we are submitting a Fiscal Year 1984 budget request which continues to emphasize a strong aeronautical research and technology program, including a strengthened fundamental research program which will continue to provide the technical base upon which future aircraft designs can be based.

The centerpiece of our proposed aeronautics program for Fiscal Year 1984 is the new Numerical Aerodynamic Simulation (NAS) activity, which will be developed over the course of the next few years. The NAS capability will include a large computer system which will make it possible to perform most of the calculations required to design a new aircraft with sufficient accuracy and reliability to significantly reduce the long and expensive process of wind tunnel and flight testing now necessary. There is every reason to believe that the computer technology to achieve this objective can be developed in the next few years, and there is no question that the capability the NAS represents will make it possible to design new airplanes much more effectively. The investment made in NAS will provide incentives for various elements of the computer industry to produce machines which will be able to take advantage of major commercial applications. Developments of this kind will enhance the competitive posture of the United States in this important international market.

The Fiscal Year 1984 budget proposed by the Administration also contains a number of items which

are very important to the future of NASA's health as an institution. It is clear that the achievements I have outlined earlier in my testimony would not have been possible without a strong NASA institution. In the Fiscal Year 1984 budget before you, there is a substantial increase in funding for construction of facilities—$150 million as compared to approximately $100 million in Fiscal Year 1983. We also are proposing the maintenance of the same number of civil service positions in Fiscal Year 1984 as we have in Fiscal Year 1983. The maintenance of our civil service strength is particularly significant because this manpower level will afford an opportunity for NASA to hire some of the best recent graduates of the foremost science and engineering schools in the Nation. We plan to take aggressive steps to bring in the best people we can find in order to stengthen NASA's institution for the long term.

In the past year concern has been expressed in the press and in the Congress about the appropriate relationship between NASA and those elements of the National security establishment with responsibility for space operations. I would like to take this opportunity to state categorically that *this Administration is strongly committed to separate space programs, one dealing with civil sector operations and the other with those related to the National security*. The President's space policy is very clear on this point, stating that, "The United States space program will be comprised of two separate, distinct, and strongly interacting programs—National security and civil. Close coordination, cooperation, and information exchange will be maintained among these programs to avoid unnecessary duplication." We have continued to maintain separate programs and to have separate policies governing these programs; but we have also developed a number of new interactive relationships which promote efficient coordination and management while protecting the integrity of NASA programs. We have just finalized a renegotiated Shuttle pricing agreement with the Department of Defense. This new agreement will provide NASA with increased reimbursements of approximately $1 billion more in the next five years than the agency would have received under the previous policy agreed to in 1977. This revised policy will raise the Shuttle launch cost to the Department of Defense by almost 150 percent, in Fiscal Year 1975 dollars, above the previously set launch price. We also have several Memoranda of Understanding with the Department of Defense which deal with various aspects of programs in order to avoid the unnecessary duplication which the President mentions in his space policy.

I would be remiss if I did not conclude this portion of my testimony by talking about the future. The President's space policy recognizes the importance of developing new concepts which provide a strong vision of the future, not only for our space program, but for the Nation as a whole. In his space policy, the President requires NASA to "continue to explore the requirements, operational concepts, and technology associated with permanent space facilities." The Space Shuttle makes it easier to establish larger permanent facilities in space. NASA's proposed Fiscal Year 1984 budget includes modest funding for definition and planning efforts which will allow us to understand, in greater detail, how such permanent facilities might be developed and maintained in Earth orbit. These studies will provide a basis for considering possible future proposals to establish a permanent manned station in Earth orbit.

RESEARCH AND DEVELOPMENT PROGRAMS

BUDGET PLAN
(Thousands of Dollars)

	FY 1982	FY 1983	FY 1984
SPACE TRANSPORTATION SYSTEMS	3,089,850	3,597,800	3,498,000
Space transportation capability development	2,623,350	2,144,100	1,927,400
Space transportation operations	466,500	1,453,700	1,570,600
SPACE SCIENCE AND APPLICATIONS	896,200	1,034,100	1,068,000
Physics and astronomy	322,433	441,000	514,600
Planetary exploration	210,000	186,400	205,400
Life sciences	39,500	55,700	59,000
Solid earth observations	149,400	132,200	74,400
Environmental observations	133,023	156,900	163,000
Materials processing in space	16,244	22,000	21,600
Communications	21,300	32,400	21,100
Information systems	4,300	7,500	8,900
TECHNOLOGY UTILIZATION	8,000	9,000	4,000
AERONAUTICS AND SPACE TECHNOLOGY	375,800	403,000	438,300
Aeronautical research and technology	264,800	280,000	300,300
Space research and technology	111,000	123,000	138,000
TRACKING AND DATA ACQUISITION	402,100	498,900	700,200
TOTAL	4,771,950	5,542,800	5,708,500

OFFICE OF SPACE TRANSPORTATION SYSTEMS

BUDGET PLAN
(Thousands of Dollars)

	FY 1982	FY 1983	FY 1984
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	2,623,350	2,144,100	1,927,400
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	2,176,750	1,729,300	1,500,000
UPPER STAGES	106,700	167,000	143,200
SPACELAB	100,800	121,200	119,600
ENGINEERING AND TECHNICAL BASE	183,100	70,300	93,100
PAYLOAD OPERATIONS AND SUPPORT EQUIPMENT	46,300	44,400	53,200
ADVANCED PROGRAMS	9,700	11,900	15,000
TETHERED SATELLITE SYSTEM	---	---	3,300
SPACE TRANSPORTATION OPERATIONS	466,500	1,453,700	1,570,600
SHUTTLE OPERATIONS	435,300	1,370,700	1,520,600
EXPENDABLE LAUNCH VEHICLES	31,200	83,000	50,000

SPACE SCIENCE AND APPLICATIONS

BUDGET PLAN
(Thousands of Dollars)

	FY 1982	FY 1983	FY 1984
PHYSICS AND ASTRONOMY	322,433	441,000	514,600
SPACE TELESCOPE DEVELOPMENT	121,500	137,500	120,600
GAMMA RAY OBSERVATORY DEVELOPMENT	8,000	34,500	89,800
SHUTTLE/SPACELAB PAYLOAD DEVELOPMENT AND MISSION MANAGEMENT	47,556	83,000	92,900
EXPLORER DEVELOPMENT	33,300	34,300	48,700
MISSION OPERATIONS AND DATA ANALYSIS	45,300	74,800	79,500
RESEARCH AND ANALYSIS	22,935	28,800	29,800
SUBORBITAL PROGRAM	43,842	48,100	53,300
PLANETARY EXPLORATION	210,000	186,400	205,400
GALILEO DEVELOPMENT	115,700	91,600	79,500
VENUS RADAR MAPPER MISSION	---	---	29,000
INTERNATIONAL SOLAR POLAR MISSION	5,000	6,000	8,000
MISSION OPERATIONS & DATA ANALYSIS	42,600	38,500	43,400
RESEARCH AND ANALYSIS	46,700	50,300	45,500
LIFE SCIENCES	39,500	55,700	59,000
SOLID EARTH OBSERVATIONS	149,400	132,200	74,400
LANDSAT-4	81,900	61,700	15,800
EXTENDED MISSION OPERATIONS	2,800	1,800	1,000
SHUTTLE/SPACELAB PAYLOADS	12,300	13,800	15,000
GEODYNAMICS	22,900	26,200	28,000
AgRISTARS	14,000	15,000	---
RESEARCH AND ANALYSIS	15,500	13,700	14,600
ENVIRONMENTAL OBSERVATIONS	133,023	156,900	163,000
UPPER ATMOSPHERE RESEARCH AND ANALYSIS	20,500	27,700	29,600
ATMOSPHERIC DYNAMICS AND RADIATION RESEARCH AND ANALYSIS	22,300	26,500	28,400
OCEANIC PROCESSES RESEARCH AND ANALYSIS	16,900	17,000	18,200
SPACE PHYSICS/ATD RESEARCH & ANALYSIS	12,123	15,200	15,700
SHUTTLE/SPACELAB PAYLOAD DEVELOPMENT	4,100	3,700	7,600
OPERATIONAL SATELLITE IMPROVEMENT PROGRAM	6,000	6,000	600
EARTH RADIATION BUDGET EXPERIMENT	24,000	24,000	15,500
EXTENDED MISSION OPERATIONS	16,100	22,800	27,400
UPPER ATMOSPHERE RESEARCH SATELLITE EXPERIMENTS AND MISSION DEFINITION	6,000	14,000	20,000
HALOGEN OCCULTATION EXPERIMENT	5,000	---	---
MATERIALS PROCESSING IN SPACE	16,244	22,000	21,600
COMMUNICATIONS	21,300	32,400	21,100
INFORMATION SYSTEMS	4,300	7,500	8,900

TECHNOLOGY UTILIZATION

TECHNOLOGY UILIZATION	8,000	9,000	4,000

RESEARCH AND PROGRAM MANAGEMENT

BUDGET PLAN
(Thousands of Dollars)

INSTALLATION	FY 1982	FY 1983	FY 1984
Johnson Space Center	186,569	195,193	204,616
Kennedy Space Center	155,958	163,341	173,472
Marshall Space Flight Center	172,059	183,952	186,663
National Space Technology Laboratories	6,604	6,332	9,302
Goddard Space Flight Center	169,132	180,865	183,726
Ames Research Center	101,054	107,374	108,835
Langley Research Center	126,591	134,189	139,081
Lewis Research Center	106,412	115,920	121,857
NASA Headquarters	109,755	111,884	119,948
TOTAL	1,134,134	1,199,050	1,247,500

AERONAUTICS AND SPACE TECHNOLOGY

BUDGET PLAN
(Thousands of Dollars)

	FY 1982	FY 1983	FY 1984
AERONAUTICAL RESEARCH AND TECHNOLOGY	264,800	280,000	300,300
RESEARCH AND TECHNOLOGY BASE	(172,758)	(197,700)	(227,800)
SYSTEMS TECHNOLOGY PROGRAMS	(92,042)	(82,300)	(72,500)
Rotorcraft Systems Technology	21,665	22,300	27,600
High-Performance Aircraft Systems and Technology	13,800	15,000	19,900
Subsonic Aircraft Systems Technology	27,022	17,000	5,000
Advanced Propulsion Systems Technology	26,155	28,000	---
Numerical Aerodynamic Simulation	---	---	20,000
Other Systems Technology	3,400	---	---
SPACE RESEARCH AND TECHNOLOGY	111,000	123,000	138,000
RESEARCH AND TECHNOLOGY BASE	(104,646)	(115,100)	(126,200)
SYSTEMS TECHNOLOGY PROGRAMS	(3,354)	(4,900)	(7,200)
Space flight experiments	1,054	1,900	5,500
Long duration exposure facility	1,360	2,100	700
Ion auxiliary propulsion system	740	900	1,000
STANDARDS AND PRACTICES	(3,000)	(3,000)	(4,600)

SPACE TRACKING AND DATA SYSTEMS

TRACKING AND DATA ACQUISITION	402,100	498,900	700,200
SPACE NETWORK	(21,800)	(103,800)	(294,700)
Tracking and data relay satellite system	---	51,300	242,900
Other space network	21,800	52,500	51,800
GROUND NETWORK	(237,457)	(242,400)	(231,500)
COMMUNICATIONS AND DATA SYSTEMS	(130,343)	(139,300)	(159,800)
ADVANCED SYSTEMS	(12,500)	(13,400)	(14,200)

FISCAL YEAR 1984 CONSTRUCTION OF FACILITIES PROGRAM

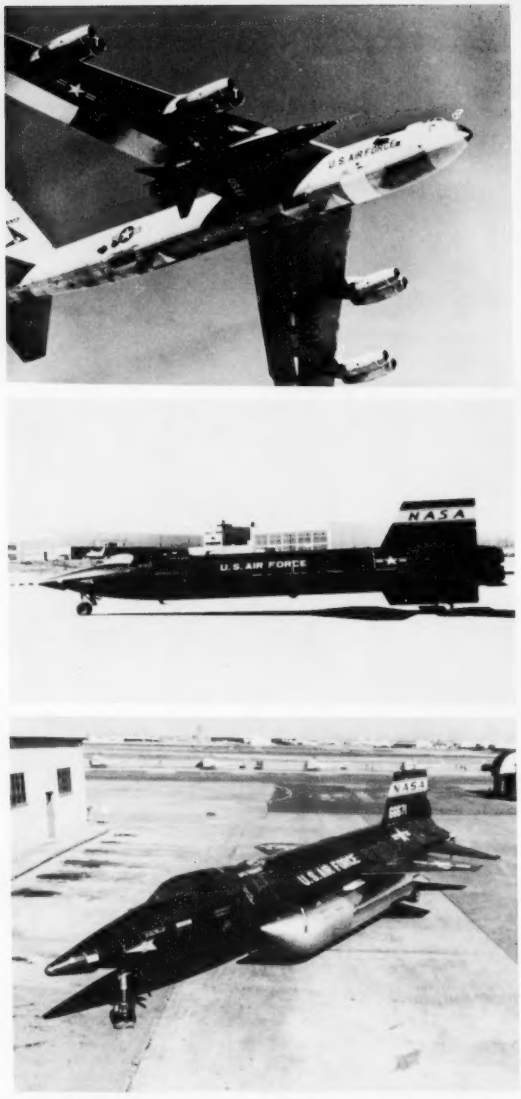
BUDGET PLAN
(Thousands of Dollars)

PROJECTS BY INSTALLATION

Jet Propulsion Laboratory	4,300
Construction of frequency standards laboratory	2,700
Modification to space flight operations facility	1,600
Ames Research Center	3,900
Construction of fluid mechanics laboratory	3,900
Hugh L. Dryden Flight Research Facility	800
Construction of aeronautical tracking facility	800
Langley Research Center	9,500
Modifications and addition for composite materials laboratory (1293A)	5,100
Modifications to 30- by 60-foot wind tunnel (643)	4,400
Lewis Research Center	10,600
Modifications for small engine component testing facility	7,000
Modifications to icing research tunnel	3,600
Space Shuttle Facilities at Various Locations as Follows:	41,300
Modifications for additional chillers for mission control center (JSC)	2,300
Modifications to mobile launch platform #3 (KSC)	27,300
Modifications of manufacuring and final assembly facilities for external tanks (MAF)	11,700
Space Shuttle Payload Facilities at Various Locations as Follows:	12,000
Construction of cargo hazardous servicing facility (KSC)	9,000
Modifications to spacecraft assembly and encapsulation facility (SAEF-2) for cargo processing	3,000
Various Locations	1,700
Relocation of 26-meter STDN Antenna, Spain (JPL)	1,700
Repair of Facilities at Various Locations, Not in Excess of $500,000 per Project	19,500
Minor Construction of New Facilities and additions to Existing Facilities at Various Locations, Not in Excess of $250,000 per Project	4,800
Facility Planning and Design	9,200
Subtotal	142,100
Reimbursement to GSA For NASA Utilized Property at Ellington Air Force Base, Texas, As Directed by OMB	8,400
TOTAL	150,500

NASA's 25th Anniversary, Oct. 1, 1983
Historical Calendar for March

Date	Event
3/2/65	Launch of Centaur Test V (Atlas Centaur)
3/3/59	Launch of Pioneer IV (Nu 1)
3/3/69	Launch of Apollo IX
3/3/72	Launch of Pioneer-F (10)
3/4/68	Launch of OGO-V (E)
3/4/82	Launch of Intelsat V F-4
3/5/68	Launch of Explorer XXXVII
3/5/74	X24B, first supersonic flight
3/5/78	Launch of Landsat C
3/7/62	Launch of OSO I
3/8/67	Launch of OSO III
3/8/74	Launch of UK-X4
3/10/77	Launch of Palapa-B
3/10/77	Uranus ring discovered
3/11/60	Launch of Pioneer-V (P-2) (Alpha 1)
3/12/72	Launch of TD-1 (ESRO)
3/13/71	Launch of IMP-1 (Explorer 43)
3/16/65	Goddard Space Flight Center dedicated
3/16/66	Launch of Gemini VIII
3/16/74	Mariner 10 flyby of Mercury
3/19/64	Launch of Beacon Explorer A (S-66)
3/19/70	X24A, first powered flight
3/20/70	Launch of NATOSAT-1 (NATO-A)
3/21/65	Launch of Ranger 9
3/22/82	Launch of Space Shuttle 3
3/23/65	Launch of GT 3
3/23/67	Launch of Intelsat II F-3
3/24/61	Launch of Mercury MR-BD
3/25/60	X-15 first research flight
3/25/61	Launch of Explorer X (P-14)
3/26/76	Launch of RCA Satcom 2
3/27/64	Launch of Ariel II (UK)
3/27/69	Launch of Mariner VII (G)
3/28/63	Saturn Test (SA-4)
3/31/78	Launch of Intelsat IVA F-6



Evolution of the X-15—Dramatic view of the first experimental X-15 rocket plane attached under the wing of its launching aircraft, an Air Force B-52 (top photo). The X-15s were built by North American Aviation, El Segundo, Calif. (now part of Rockwell International). Middle photo is full side view of the first X-15. Bottom photo is of a modified X-15 (airplane number 2) produced in 1964, that was equipped with additional external fuel tanks. The body of this model was slightly longer and the additional tanks increased the engine burning time by about 145 seconds at full throttle, thereby raising the speed of the aircraft by almost 1,300 mph. A modified X-15 reached a speed 6.7 times the speed of sound or 4,520 mph. Cost of the X-15 program, including construction of three aircraft, was about $300 million. The first X-15 is on display at the Smithsonian Institution's National Air and Space Museum, Washington, D.C.

Launch of Space Shuttle Challenger Set for Early April

Challenger's maiden launch for the sixth Space Shuttle mission has been rescheduled for April 4, a delay of about 2½ months. The delay of the sixth mission has impacted the launch dates of the next two missions, now rescheduled for late June and late August, respectively. However, NASA hopes to meet the scheduled launch date of Sept. 30 for the ninth flight, when Spacelab 1 is to be carried aboard Space Shuttle Columbia.

The European Space Agency, NASA's customer for the ninth flight, has indicated that adherence to the Sept. 30 date is highly desirable because of the orbital and data collection requirements of their experiments. The Spacelab astronomy experiments, for example, require the launch window provided by the Sept. 30 date and cannot be launched at a later date because of the effect on this window. In addition, to provide maximum data collection for all experiments presently manifested for Spacelab 1, it is necessary to have both Tracking and Data Relay Satellites (TDRS) up and operational. But adherence to NASA's revised launch schedules for missions six, seven, and eight would meet this criteria: the first of these satellites is scheduled for launch on the sixth Space Shuttle mission; the second TDRS for the eighth launch in July.

Lt. General J. A. Abrahamson, Associate Administrator for the Office of Space Flight, terms NASA's catch-up schedule over the next few months an "optimistic one," but notes that if this schedule is met, it will represent "a fantastic recovery effort on the part of the NASA and contractor teams."

As part of this new effort, work will be divided into four shifts, instead of the traditional three, with supervisory staff and trained technicians reallocated among these shifts. The four-shift system is expected to be more cost effective because overtime demands on any one shift will be lessened. Work flow also will be increased because several teams will be working at any one time during the flight readiness phase.

The delay of the sixth Space Shuttle mission was caused by two separate leakage problems in the Space Shuttle main engine system. A flight readiness firing of Challenger's main engines was scheduled for Dec. 18 as "an extra measure of confidence," according to General Abrahamson. Post-firing data analysis revealed a hydrogen leak in Challenger's Shuttle main engine number 1. Source of the leak could not be pinpointed so an additional flight readiness firing was performed on Jan. 25, equipped this time with a more sophisticated network of leak detection devices. On Jan. 29 the source of this leak was identified as a hairline crack on the manifold of the main combustion chamber, measuring about three quarters of an inch long.

During manufacture of this engine at the Rocketdyne assembly plant, Canoga Park, Calif., a machine tool slipped and damaged the manifold outlet. At the time the damage occurred the manifold had already been machine welded to the main combustion chamber. The only way to repair the damage was to cut out the affected area and hand weld a new section into the existing manifold.

The crack that caused the hydrogen leak was traced to the hand welded replacement part. Investigators have hypothesized that the hand-welded section could not withstand the operational stress imposed on this section by a firing. Metallurgical tests have revealed that the manifold's copper lining tore, probably as a result of overheating during the repair welding. The result of this modified process was the hairline fracture on the replacement manifold section.

NASA decided to replace this engine (number 2011) with engine 2016, rated at the same level as Challenger's other two engines at 104 percent. Engine 2016 arrived at Kennedy Space Center on Feb. 4 and engine 2011 was removed. On Feb. 8, leak checks performed during installation of engine 2016 revealed a leak in the liquid oxygen heat exchanger. Ironically this faulty heat exchanger had passed all required tests prior to its shipment to Kennedy Space Center from the National Space Technology Laboratories in Mississippi.

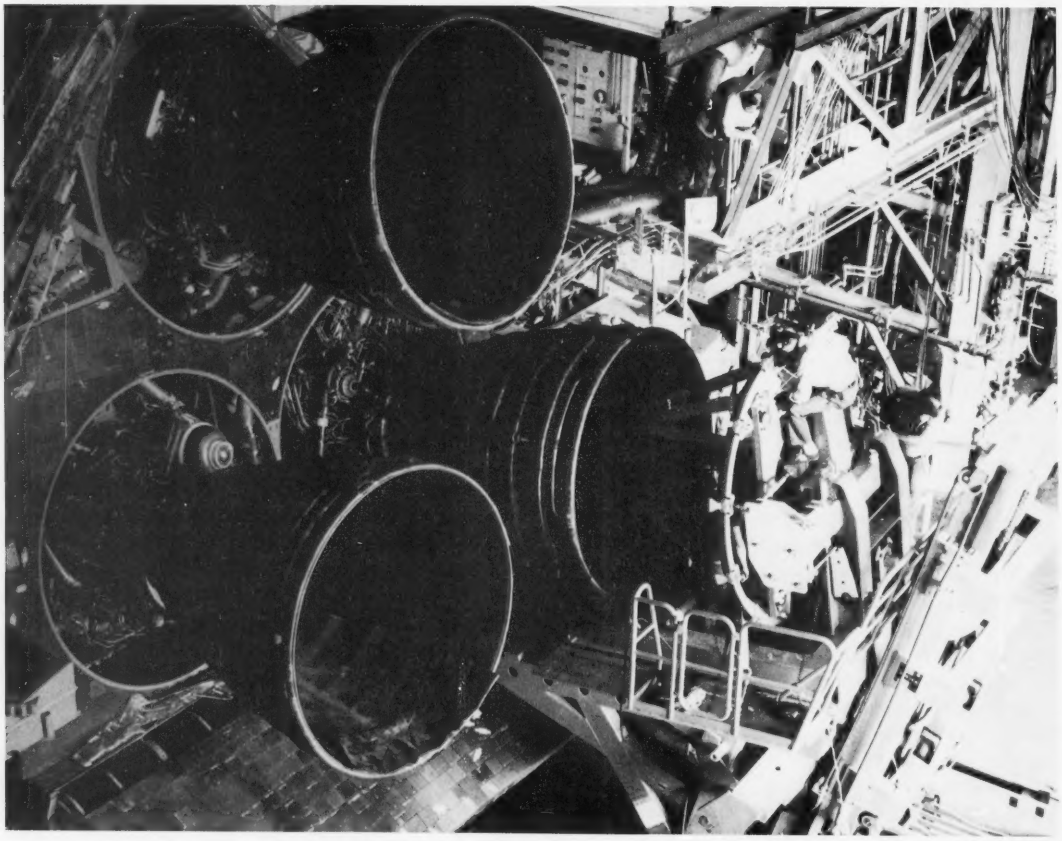
NASA has elected to replace engine 2016 with engine 2017, the only available spare rated at 104 percent thrust. Engine 2017 successfully passed a 500-second duration test firing at National Space Technology Laboratories on Feb. 15. Engine 2007, a flight spare for Columbia, also was shipped to Kennedy Space Center in February as a precautionary measure (backup engine). However this engine's use as a replacement for Challenger is not as desirable as the use of engine 2017 because engine 2007 is rated at 100 percent rated power level.

Asked if the problems encountered with Challenger's launch cast a doubt on the quality of Space Shuttle main engine processing and checkout procedures, Gen. Abrahamson responded by saying "quality is ensured by a series of screens, beginning with the manufacturing and continuing through to flight. We didn't catch the problems that we would have anticipated catching early on, but *we did catch them*, and that's what is important." He added, "NASA will not compromise

with safety; we are prepared to do whatever is necessary to ensure that each mission is a safe and successful one."

The problems with Challenger's main engines have resulted in improved operational testing at three levels: at the Rocketdyne Facility; at the National Space Technology Laboratories during acceptance testing procedures; and at Kennedy Space Center during pre-launch tests. This revised testing procedure now includes "increased sensitivity to engine leaks and how to get at them," according to Gen. Abrahamson, and will become part of the standard checkout for further launches. Confidence in the thoroughness of this newly devised testing prompted Abrahamson to say that it is unlikely that a third flight readiness firing will be performed before launch.

The problems with Challenger's launch have caused NASA to reassess its Space Shuttle main engine power level requirements for launches through 1985. "Availability of spare engine parts are a historical budget problem," noted Abrahamson, and one that is not likely to be overcome in the very near future. As a result of the increased parts shortage created by the recent problems with Challenger, NASA has redefined the operational thrust requirements for Space Shuttle main engines for flights through 1985 as 104 percent. This new operational level should not affect any payloads already scheduled for flight, specifically those



Main Engine Changeout—The three main engines of Space Shuttle orbiter Columbia being removed in the Orbiter Processing Facility at Kennedy Space Center. Two of the engines have been shipped back to the manufacturer, Rocketdyne Division of Rockwell International, Canoga Park, Calif., to be modified to run at a higher thrust level. One engine has been shipped to Kennedy Space Center as a flight spare for Challenger, if needed. All three engines will undergo a complete overhaul and power modification before they are reused again on the orbiter Atlantis.

heavier payloads such as Spacelab 1 that had been earlier earmarked as requiring a 109 percent thrust level to carry the cargo into orbit.

New high performance solid rocket motors, scheduled for first use in flight eight, are expected to increase thrust performance by about 3,000 pounds. NASA officials have determined that the remaining weight differential for heavy cargoes can be made up by making minor structural changes to Challenger (such as removing one of its three sets of cryogenic fuel cell tanks).

Use of these up-rated boosters in conjunction with the structural modifications should enable a Space Shuttle main engine cluster rated at 104 percent thrust to successfully launch leavier payloads that previously had been rated to require an operational engine cluster rated at 109 percent performance. Abrahamson anticipates that 1986 will be the earliest date in which the operational requirement will be reconfigured to require the 109 percent level.

Flight Deck Training—Space Shuttle Mission 6 astronauts Paul J. Weitz (right) and Karol J. Bobko perform one of many training exercises in the flight deck engineering mockup of the Space Shuttle at NASA's Johnson Space Center.

Astronaut Crews Named for Shuttle Flights 11 Through 13 and Spacelab 2 and 3

NASA has announced the following crew members for upcoming Shuttle and Spacelab flights:

Shuttle Flight 11

Commander:	Vance D. Brand
Pilot:	Robert L. Gibson
Mission Specialists:	Bruce McCandless, II Robert L. Stewart Dr. Ronald E. McNair

Shuttle Flight 12

Commander:	Henry W. Hartsfield
Pilot:	Michael L. Coats
Mission Specialists:	Dr. Judith A. Resnick Dr. Stephen A. Hawley Richard M. Mullane

Shuttle Flight 13

Commander:	Robert L. Crippen
Pilot:	Francis R. Scobee
Mission Specialists:	Dr. George D. Nelson Terry J. Hart Dr. James D. van Hoften

Shuttle Flight 18 (Spacelab 3)

Commander:	Robert F. Overmyer
Pilot:	Frederick D. Gregory
Mission Specialists:	Dr. Don L. Lind Dr. Norman E. Thagard Dr. William E. Thornton
Payload Specialists:	(to be announced at a later date)

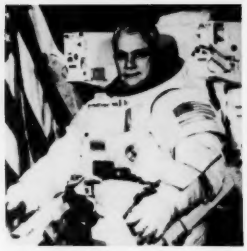
Shuttle Flight 24 (Spacelab 2)

Mission Specialists:	Dr. Anthony W. England Dr. Karl G. Henize
Other Crew:	(to be announced later)

Shuttle Flight 11 (Jan. 1984)

Vance D. Brand

Robert L. Gibson



Bruce McCandless, II

Robert L. Stewart

Ronald E. McNair

Shuttle flight 11, a Challenger launch scheduled for January 1984, will be a seven-day flight featuring the launch of Palapa B-2, the second in a series of Indonesian communications satellites which will be boosted into synchronous orbit by a D-class Payload Assist Module. Flight 11 also will be the first flight for the FLC-1, or large format camera, which will demonstrate stereoscopic high resolution photography of the Earth's geophysical features. Columbia also will carry the Payload Deployment and Retrieval System test article, a 16 × 15 foot rectangular frame with lead ballast. The reactions of the elbow, wrist and shoulder joints of this robotic arm will be tested on this flight.

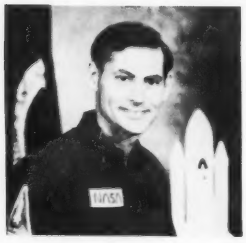
Shuttle Flight 12 (March 1984)

Henry W. Hartsfield

Michael L. Coats

Judith A. Resnick

Stephen A. Hawley



Richard M. Mullane

Shuttle flight 12, scheduled for March 1984, will be the first mission for NASA's third operational orbiter, Discovery (orbital vehicle 103). Discovery will carry the third Tracking and Data Relay Communications Satellite into orbit to complete NASA's TDRS network. Mission 12 also will carry the materials experiment assembly, a self-contained facility for a variety of multidiscipline materials processing experiments that will require activation, deactivation, and status monitoring by the astronaut crew.

Shuttle Flight 13 (April 1984)

Robert L. Crippen

Francis R. Scobee

George D. Nelson

Terry J. Hart

James D. van Hoften

Shuttle flight 13, a Challenger launch scheduled for April 1984, is known as the Solar Max Repair Mission. For this flight Challenger will climb to the highest orbit yet attained by a Space Shuttle (about 272 nautical miles) in order to rendezvous with the ailing Solar Maximum Mission satellite and carry out the first Shuttle on-orbit repair in space. This flight will be the first launch of the Long Duration Exposure Facility, a free-flyer filled with a number of passive experiments which require long term exposure to space. This facility will be retrieved on a later flight.

Shuttle Flight 18 (Spacelab 3, Sept. 1984)

Robert F. Overmyer

Frederick D. Gregory

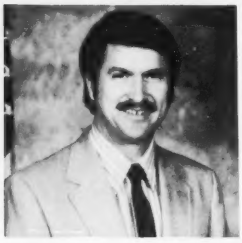
Don L. Lind

Norman E. Thagard

William E. Thornton

Shuttle flight 18 carrying Spacelab 3 aboard Columbia in September 1984 will be the first operational Spacelab mission carrying experiments in materials processing, space technology, and life sciences. Additional experiments also will conducted in astrophysics and environmental observations.

Shuttle Flight 24 (Spacelab 2, March 1985)



Anthony W. England

Karl G. Henize

Shuttle flight 24 carrying Spacelab 2 aboard Discovery in March 1985, was originally scheduled to precede Spacelab 3 into orbit as a developmental flight carrying 13 major experiments in fields such as plasma physics, infrared astronomy and solar physics. The transposition of the two Spacelab flights was caused by a delay in completion of the instrument pointing system necessary for Spacelab 2 experiments.

NASA Develops Process To Make High-Temperature Semiconductor

A team of physicists at NASA's Lewis Research Center, Cleveland, has developed a practical manufacturing process for high purity silicon carbide semiconductors that may herald the emergence of a new breed of heat-resistant electronics. Semiconductors, the tiny electronic "chips" small enough to pass through the eye of a needle, are the heart of modern microelectronics. They are used in everything from computer toys to complex spacecraft guidance systems. Until now, most semiconductors have been made of pure silicon, the main ingredient of beach sand. Unrivaled in purity, these silicon chips, however, are adversely affected by heat. Electronics using silicon semiconductors are destroyed by temperatures above 315.5 degrees Celsius (600 degrees Fahrenheit).

Scientists agree that by using semiconductors made of silicon carbide, electronic packages should be capable of enduring temperatures as high as 871 C (1,600 F). Lead melts at 326.6 (620 F.) "High-temperature electronics based on silicon carbide semiconductors can be of great value to a wide variety of users," say Lewis physicists William Nieberding, Anthony Powell and Herbert Will, chiefly involved in the development of the new process. "Such electronics at Lewis, for example, could give us the ability to place electronic packages and switches inside experimental turbine engines to monitor and control the engine to a degree never before possible," Nieberding said.

"Silicon carbide semiconductors would also be valuable in improved instrumentation for nuclear-powered generators—both in space and on the ground—and enable NASA to build planetary probes able to withstand the searing heat encountered on the surface of planets like Venus or Mercury," continued Nieberding. "Still another application area of high potential would be extremely high frequency electronics where silicon carbide may prove to be a key element in developing frequency bands measured in hundreds of Gigahertz or billions of cycles per second."

The search for a practical production process for silicon carbide semiconductors is not new. Researchers in the 1950s, realizing how sensitive silicon electronics were to heat, set out to find a semiconducting material capable of withstanding much higher temperatures. One of the materials considered was diamond, but natural diamonds are far too expensive to use as a semiconducting material and the man-made variety lack purity and other essential properties.

Military aviation was the driving force behind much of the early research into silicon carbide semiconductors in those early years. The rationale: without high-temperature electronics, supersonic jets need exotic cooling systems to protect their avionics. These would include pumping highly flammable jet fuel around the aircraft's electronics to absorb damaging heat.

Early silicon carbide efforts were a failure because sufficiently pure crystals of silicon carbide were impossible to make and experimental production methods were not repeatable, according to Powell. Research on finding a repeatable process continued in labs all over the world during the 1960s but was abandoned in the United States in 1973. It was resumed in America two years ago when the Navy and NASA began looking for ways of putting computers in direct, on-line control of jet engines.

"At the same time the program was revived, we received a request from a Japanese physicist to join us at Lewis on a research fellowship," Powell said. "He had been doing advanced research into silicon carbide with a unique idea." Dr. Shigihiro Nishino was granted the fellowship and spent the next 15 months at Lewis working with Nieberding, Powell and Will on adapting his novel idea of making the elusive silicon carbide semiconductor.

Nishino's theoretical process began by using standard silicon disks as a substrate for the construction of the

silicon carbide semiconductor. This was similar to other, unsuccessful methods tried in the past; pure silicon being desirable as a base because it would impart its highly regular crystal structure to the silicon carbide that could later be deposited above it.

The main stumbling block in the old process, according to Nieberding, was that the spacing between atoms of the two materials was significantly different. This caused the upper layer of deposited silicon carbide to break into tiny unusable pieces. The resulting uneven surface destroyed the material's ability to act as a semiconductor.

"Nishino's contribution chiefly involved laying down a very thin buffer layer of irregular silicon carbide crystals over the silicon substrate," Nieberding explained. "This buffer layer of tiny crystals (about 10,000 times thinner than a human hair) acted as a bridge between the two slightly different crystals structures."

Lewis scientists worked several months constructing a small lab that would permit them to perfect a way of depositing the buffer layer and the subsequent layer of silicon carbide.

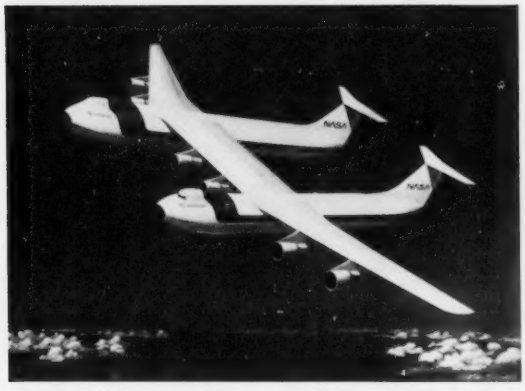
The process that finally evolved centers around heating a pure silicon wafer in a radio frequency heated oven and then injecting selected gases to form the silicon carbide crystal buffer layer. The result is a film surface upon which other gases introduced later into the oven can deposit a uniform layer of pure silicon carbide crystal—thus forming the silicon carbide semiconductor. The involved and highly controled process requires about six hours.

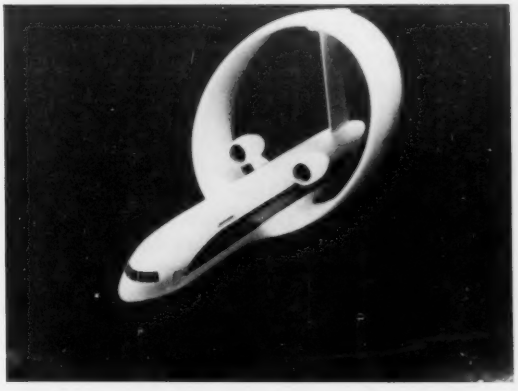
Nieberding, Will and Powell have used the silicon carbide thus far produced in their rig to build diodes and other devices for evaluation. "Early indications show that our efforts have been a success," Powell said, adding that their work has really just begun. "Now we are looking at ways to make the process more efficient."

Like so many technical innovations, no one is quite sure at this point how valuable the silicon carbide chip will be. But even conservative estimates indicate that a door may have been opened to a new world of high-temperature electronics.

NASA Transfers Landsat to NOAA

NASA transferred the operation and management of the Landsat Earth remote sensing satellite system to the National Oceanic and Atmospheric Administration. Under the terms of the Jan. 31 transfer, NASA





Innovations in Aircraft Design—Two new conceptual studies conducted jointly by NASA's Langley Research Center and Lockheed-Georgia Co. At left is a large multi-body transport aircraft that would offer potential weight, performance and cost benefits over conventional single-body aircraft. Estimated direct operating costs would be almost 11 percent less than a single-body aircraft of equivalent payload capacity while the flyaway cost would be 9 to 15 percent less. At right is Lockheed-Georgia's futuristic "Ring Wing" aircraft. On the drawing board for the year post-2000 time period, such an aircraft would contain many advanced technologies but its most advanced technology would be the configuration itself with the wings curling upward to meet above the fuselage. Before the end of the year Lockheed-Georgia will conduct preliminary wind tunnel tests on the design concept at NASA's Langley Research Center. Langley is NASA's principal developmental center for long-range transport concept studies.

relinquished operational control over the Landsat 4 satellite (except the Thematic Mapper), and the ground operations control center and multispectral scanner data processing facility, both at Goddard Space Flight Center, Greenbelt, Md. Because of their Goddard location, NOAA will reimburse NASA for use of certain building facilities and for utilities.

Landsat 1 and 2 are no longer operational. Landsat 3 will be retired later this year because of age related degradation. NOAA's National Environmental Satellite, Data and Information Service (NESDIS) will operate the Landsat system and, under separate arrangement with the Department of Interior, also will control the satellite data distribution facility at Sioux Falls, S. Dak. Data received from the Landsat satellites have been distributed in the form of images and computer-compatible digital tapes by the Interior Department's EROS Data Center in Sioux Falls.

In addition, NOAA also will assume responsibility for the Landsat 4 backup spacecraft, Landsat D′ (D prime) presently undergoing final checkout and assembly at the General Electric Space Division facility in Valley Forge, Pa. After its completion and testing, NASA will be responsible for Landsat D′ during storage and will perform periodic retesting for NOAA. Landsat D′ will replace Landsat 4 when it is no longer operational; lifetime estimates of Landsat 4 indicate a mid-1985 replacement date.

NASA retained management control of Landsat 4's Thematic Mapper, one of two Earth-survey instruments aboard the spacecraft and will continue to use this instrument during the experimental research and development phase of the new sensor system. NASA is still developing computer analysis programs for data from the Thematic Mapper and is sponsoring a number of scientific investigations into the potential of Thematic Mapper data both for Earth survey applications and for Earth science studies. NASA expects to transfer control of Thematic Mapper to NOAA in early 1985 according to terms of the Landsat transfer agreement.

On Feb. 15, several weeks after the operation and management transfer of Landsat 4 to NOAA, the X-brand transmitter on the satellite failed to operate. This transmitter sends data from the Thematic Mapper to ground stations which in turn produces pictures of the Earth in 90-foot squares. These highly detailed pictures are used in mineral exploration, water quality control and crop assessment. Less detailed pictures from Landsat 4's multispectral scanner instrument, however, continue to be received.

NASA and the General Electric Co., Valley Forge, Pa., the prime Landsat contractor, and TRW, Redondo Beach, Calif., the X-band transmitter contractor, are currently studying the problem. Unless it can be resolved, no more Thematic Mapper data can be received until the Tracking and Data Relay Satellite, scheduled for launch aboard Challenger in late March, is operational.

The Landsat program began in 1972 when the (then) Earth Resources Technology Satellite-1 (Landsat-1) was launched. The program began as a research and development effort to determine the usefulness of satellite multispectral information, provided as synoptic views of the Earth's surface.

In the 10 years since the first Landsat was orbited, the program has developed into a valuable source of information for agricultural and urban planning, geologic exploration, land management studies, snow melt and flood runoff analysis, crop stress location, and other tasks requiring large-scale views of Earth surface areas.

Telescope Test Plate—NASA's Marshall Space Flight Center has produced a 152-centimeter (60-inch)- wide, 305-cm (120-in.)-long, 13-cm (5-inch)-deep piece of aluminum weighing approximately 1,633 kilograms (3,600 pounds) for special vibration tests for the Space Telescope. This aluminum tooling plate is to be used as the base structure for a series of vibration tests of the latches that will be used to attach scientific instruments to the Space Telescope. A tooling plate is a cast piece of aluminum rather than a billet (piece) of rolled material. Majority of the work on the plate was performed by Marshall test laboratory technician, Grover Willoughby, shown at left in photo.

What's New in NASA Television and Radio Programming

Programs released in February (running through March 4):

Television:

Aeronautics and Space Report—Two part series (4½ minutes)
Teleoperators (2 min., 37 sec., through Feb. 20)
Icing Research (1 min., 15 sec., through Feb. 20)

Infrared Astronomical Satellite (2 min., 3 sec., Feb. 21-Mar. 4)
Volcanic Cloud Studies (2 min., 27 sec., Feb. 21-Mar. 4)

Radio:

Space Techniques Used in the World of Art (14½-minute monthly report; featuring David Glackin, Jet Propulsion Laboratory)

International Sun-Earth Explorer (4½-minute weekly report; featuring Dr. Stephen Paddack, Goddard Space Flight Center)

Icing Research (4½-minute weekly report; featuring Jack Reinmann, Lewis Research Center)

Recent Discoveries at Uranus (4½-minute weekly report; featuring Dr. John Clark, Univ. of Calif., Berkeley)

AXAF . . . A New Window on the Universe (4½-minute weekly report; featuring Carroll Dailey, Marshall Space Flight Center)

Space Notes (1 minute each):
Challenger's Maiden Flight
Revolution in Communications
Watching the Birth and Death of Stars
Baffling Discovery by Arecibo Telescope
Shuttle Imaging Radar
Most Distant Object in Universe Discovered
International Sun-Earth Explorer
Satellite Images Reveal New Ocean Features
Detecting Minerals from Space
Spacelab

Copies of television tapes are sent simultaneously to all NASA Visitor Information Centers and Public Affairs Offices, and to 650 television stations nationwide as well as to 425 cable television systems via the satellite SATCOM III. Five hundred television stations receive material formatted as a 4½-minute program; the remaining 150 stations receive a 90-second "spot"—a condensed version of the 4½-minute presentation.

Copies of NASA radio tapes listed in this column are available upon request from your local NASA Public Affairs Office or by phoning Ivelisse Rodriguez at (202) 755-8354; FTS 755-8354; or by mailing your request to her at the following address: NASA Headquarters, Public Affairs Division, Mail Code LFD-8, Room 6102, Washington, D.C. 20546. Rodriguez welcomes your ideas or suggestions for future topics.

Contractor News

Informatics General Corp., Professional Services Operations West, Palo Alto, Calif., has been selected as the successful offerer for final negotiations to provide computer software services for NASA's Ames Research Center, Moffett Field, Calif. The resulting agreement will be a new contract for continuing support services needed to fulfill the Center's computer software services requirements. Types of service include formulation, applications and systems programming, systems design and engineering, software management and maintenance and modification of existing software. The contract will provide for a base period of three years with an unpriced option for a subsequent two years. The approximate value over the three-year term is $16.1 million.

General Dynamics Corp., Convair Division, San Diego, Calif., has been awarded an $8.8 million follow-on cost-plus-award-fee contract by NASA's Lewis Research Center, Cleveland, to support the Atlas/Centaur launch vehicles program. Under terms of this contract, General Dynamics will provide management and engineering services through Dec. 31, 1983; these services will be carried out primarily at the Convair plant in San Diego with additional effort at the Eastern Space and Missile Center, Fla. Centaur, the nation's first high-energy, liquid hydrogen-liquid oxygen rocket vehicle, is used as a second stage in a combination Atlas/Centaur launch vehicle. In 1983 Atlas/Centaurs are scheduled to launch two Intelsat Communications satellites.

NASA's John F. Kennedy Space Center, Fla., has issued a request for proposals to industry which will lead to the selection of a single contractor for the processing of the Space Shuttle at both the Kennedy Space Center and Vandenberg Air Force Base, Calif., launch facilities. Both NASA and the Air Force will consolidate contracts for flight hardware processing at both the Florida and California launch sites. At present, processing of Space Shuttle hardware is carried out at the launch site by several contractors who supply the flight hardware.

The Shuttle Processing Contract, to be awarded during 1983, consolidates under a single contract the responsibility for all Shuttle flight hardware processing, launch and landing activities, as well as the operation and maintenance of related ground systems at Kennedy and Vandenberg.

The contract should result in significant cost savings during the Shuttle operational era. It will minimize

interfaces at the launch and landing site and focus clear responsibility on a single contractor. This focus of responsibility will improve flight safety and mission effectiveness.

The successful contractor will phase in the processing of flight hardware at Kennedy during a transition period as it is demonstrated that the contractor can safely and effectively accomplish the task. The transition at Vandenberg will be time-phased to permit the contractor to assume full launch responsibility for the first launch from that site.

United Space Boosters, Inc., has been awarded a $13.9 million extension of its current contract by NASA's Kennedy Space Center, Fla., to perform processing operations for the solid rocket boosters used on the Space Shuttle. Under terms of the contract, the company will perform, at the Kennedy Space Center, receiving inspections, assembly and checkout of all the booster segments and associated hardware through pre-launch, launch, post-launch, recovery and disassembly operations. The cost-plus-incentive-award fee contract covers the period from Jan. 1 through Sept. 30, 1983.

13th Anniversary—March 15 marks the 13th year of publication of NASA Activities. Over the years the magazine has undergone graphics and printing changes (photo above); however, some of its content features information that has remained since the first issue was printed 13 years ago: Launch Schedules, expanded in 1981 to include Space Shuttle as well as Expendables; Patents for Inventions; Administrator's Message, which has evolved from a short letter format in 1971 to a column in 1982; and Another Dividend from Air and Space, a technology spinoff feature. Today over 34,000 copies of NASA Activities are published each month, distributed free of charge to all current Headquarters and field center employees. In addition, there are 1,500 subscribers and steadily growing. Available by subscription since 1971, the spiraling cost of the publication mirrors the nation's economic history: in 1971 the yearly rate was $1; single copy price 15 cents. Today's subscription rate has reached $20 per year, $1.75 single copy price. One also can find NASA's budget history reflected in the technology spinoff feature of NASA Activities that appears on the back page of each edition. In Dec. 1972, a masthead for this feature read "Are You Getting Your 2¢ Worth from Space?", indicating the amount of each citizen's tax dollar devoted to NASA programs. By July 1973, this had changed to "Your 1¢ Worth," and by June 1977, the title was completely changed to "Another Dividend from Air and Space" to avoid any proportional quotation.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employers	Title	Patent No.	Installation
Ashby G. Lawson, NASA/LaRC	Modified spiral wound retaining ring	4,371,301	LaRC
Dean W. Sheibley, NASA/LeRC	Advanced inorganic separators for alkaline batteries and method of making the same	4,371,596	LeRC
Atul Jain, Caltech/JPL	Clutter free synthetic aperture radar correlator	4,371,873	NRO/JPL
Thomas J. Bicknell and Nicholas J. Constantinides, Caltech/JPL	Servomechanism for Doppler shift compensation in optical correlator for synthetic aperture radar	4,371,946	NRO/JPL
Dah Yu Cheng, Univ. of Santa Clara, Calif.	Noise suppressor for turbo fan jet engines	4,372,110	ARC
Robert V. Doggett, Jr., and Rodney H. Ricketts, NASA/LaRC	Aeroelastic instability stoppers for wind wind tunnel models	4,372,158 and 4,372,159	LaRC

Expendable Launches for 1983

Name	Launch Date	Vehicle	Range	Mission Remarks
*IRAS	January 25	Delta	WSMC	Infrared astronomy. NASA scientific.
NOAA-E	March 28	Atlas-F	WSMC	NOAA weather and SARSAT. Reimbursable.
Intelsat V-F	April 7	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
RCA-F	April 8	Delta	ESMC	RCA communications. Reimbursable.
NAVY-21	2d quarter	Scout	WSMC	DOD transit. Reimbursable. Call up.
GOES-F	April 28	Delta	ESMC	NOAA weather. Reimbursable.
EXOSAT	May 26	Delta	WSMC	European Space Agency. Reimbursable.
Galaxy-A	June 9	Delta	ESMC	Hughes Communications, Inc. Reimbursable.
HILAT	June	Scout	WSMC	Air Force research and development. Reimbursable.
Telstar-3A	July 28	Delta	ESMC	AT & T communications. Reimbursable.
San Marco D/L	July	Scout	SMR	International cooperative/Italy.
RCA-G	August 25	Delta	ESMC	RCA communications. Reimbursable.
AF-1	August	Scout	WFC	Air Force development program. Reimbursable.
NOAA-D	August	Atlas-F	WSMC	NOAA weather. Reimbursable.
Galaxy-B	September 22	Delta	ESMC	Hughes Communications, Inc. Reimbursable.
NATO-IIID	October 27	Delta	ESMC	NATO communications. Reimbursable.
NAVY-22	4th quarter	Scout	WSMC	DOD transit. Reimbursable. Call up.
Intelsat VA-A	December	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.

* Successful launch

Space Shuttle Launches for 1983

Orbiter	Launch Date	Launch Number	Launch Site	Payload
Challenger (OV-099)	April 4	6	KSC	TDRS-A
Challenger (OV-099)	June	7	KSC	OSTA 2; SPAS-01 Telesat-F; Palapa B-1
Challenger (OV-099)	August	8	KSC	INSAT 1-B; TDRS-B
Columbia (OV-102)	September 30	9	KSC	Spacelab 1
Challenger (OV-099)	December 14	10	KSC	DOD 84-1

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Fire Resistant Materials

After the 1967 Apollo fire, NASA intensified its fire safety research and sought new fire-retardant materials for greater protection of astronauts in an oxygen-rich environment. In atmospheres containing a high percentage of oxygen under pressure, such as manned spacecraft, fire hazard is greater than normal.

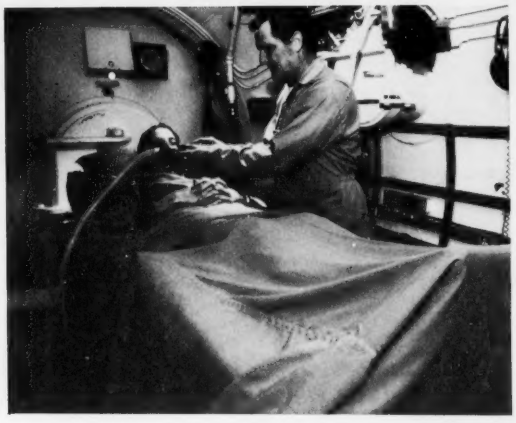
Under contract with NASA's Johnson Space Center, several companies developed new and improved materials; among them was Durette* developed by the Monsanto Co., St. Louis, Mo., which will not burn or produce noxious fumes even in an oxygen enriched environment.

Durette was selected as a material for Apollo astronaut garments. Subsequently Monsanto sold production rights for the material to Fire Safe Products, also of St. Louis, who is now producing Durette for a wide range of applications.

One example of this application is shown in the photo at top right—a hyperbaric chamber at the University of Pennsylvania Medical Center's Institute for Environmental Medicine in Philadelphia. Known for its research on deep diving and oxygen therapy, the Institute is one of several hyperbaric and undersea medical centers that use Durette fabrics for safety.

Pressure chambers are used to treat a number of conditions that respond favorably to oxygen at elevated pressures, including the diver's decompression sickness known as the "bends," chronically infected non-healing bone fractures, carbon monoxide poisoning and gas gangrene.

In the chamber the patient breathes oxygen at about twice the normal atmospheric



pressure. The increased fire risk of the hyperbaric environment is offset by reducing the amount of combustible material in the chamber through use of Durette in sheets, patient's garb and attendants' uniforms. For similar reasons, Durette is used in crew clothing, furniture and interior walls of diving chambers operated by the U.S. Navy and a number of oceanographic companies and research organizations.

* NASA does not endorse commercial products as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

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